HPS2
High Performance Solar 2

HPS2 High Performance Solar @ EMSP

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TSK FLAGSOL eltherm YARA steinmüller engineering innogy RIOGLASS Eskom UNIVERSIDADE DE EVORA DLR

DLR

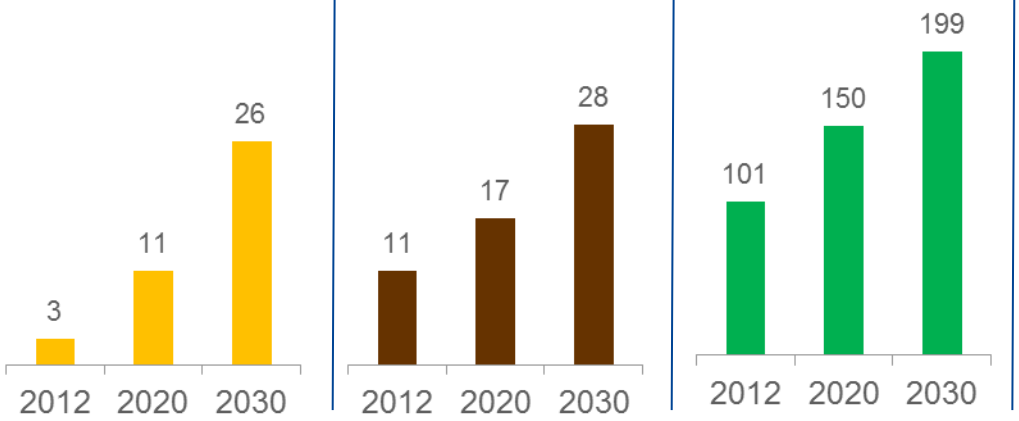
Why Concentrated Solar Power CSP?

Market forecast of IEA WEO

Steam cycle-based renewables

Average electrical capacity addition 2012-2030 [MW/y]	CSP		Geothermal		Biomass		World (all technologies)
	'12-'30	CAGR%	'12-'30	CAGR%	'12-'30	CAGR%	'12-'30 CAGR%
IEA Current Policy	1,303	13.6%	921	5.2%	5,416	3.8%	2.7%
IEA New Policy	2,206	16.7%	1,337	6.6%	6,612	4.4%	2.6%
IEA 450	4,627	21.4%	2,043	8.4%	9,144	5.5%	2.6%

Total electrical capacity IEA Current Policy [GW]



Strong growth potential - CSP highly scenario-sensitive

International Energy Agency – IEA World Energy Outlook – Report, 2014

Why Molten Salt?

Comparison to state of the art: synthetic oil

- CSP Solar Power Plants have the purpose to produce CO2-free, renewable and **dispatchable** (in comparison to PV and wind plants) electricity

- Dispatchability is achieved using a thermal energy storage

- Comparison of state-of-the-art-technology with molten-salt-technology:

  - Life steam parameters and power block efficiency:
    - State-of-the-art: 386 °C / 100 bar: **39,2%**
    - Molten salt: 550 °C / 150 bar: **45,5 %**
  - HTF-pump auxiliary load:
    - State-of-the-art: **6-7 %**
    - Molten salt: **1-2 %**
  - Volume of thermal energy storage at same capacity:
    - State-of-the-art: **100 %**
    - Molten salt @550 °C: **36 %**
  - Direct storage of HTF opens fully independent operateability of solar field and power block

HPS2 @ EMSP

Cyristallization point for further projects

Our objective:

HPS2 strives to demonstrate the feasibility of operation of a solar thermal power plant in a safe and reliable manner.

HPS2

SF	TES	SGS	BOP	CR	Infra

EMSP – Évora Molten Salt Plattform

Legend:

SF Solar Field
TES Thermal Energy Storage
SGS Steam Generating System
BOP Balance of Plant
CR Control Room I&C
Infra Infrastructure

Who is HPS2?

Industry Partners

- TSK FLAGSOL — Solar Field EPC and Collector Structure
- eltherm — Impedance Heating/EHT
- RIOGLASS — Molten Salt HCE and Mirrors
- YARA — Ca-based Nitrate Salts
- steinmüller engineering — Steam Generating System and W/S cycle

Technology Partners

- Eskom — O&M Team (South Africa)
- TSK — O&M Team (Spain)
- innogy — O&M Team (Germany)
- TSK FLAGSOL — O&M Team (Germany)
- Universidade de Évora — O&M Team (Portugal)

Research Institutes (Partner)

- DLR — Project Coordinator/ EPC/ Process Design/Scientific Program
- Universidade de Évora — Site Owner and Scientific Program, Molten Salt Piping

Sub-Contractors (selection)

- SIEMENS — DCS system (SPPA-T3000)
- SIEMENS — Electrical/I&C scope

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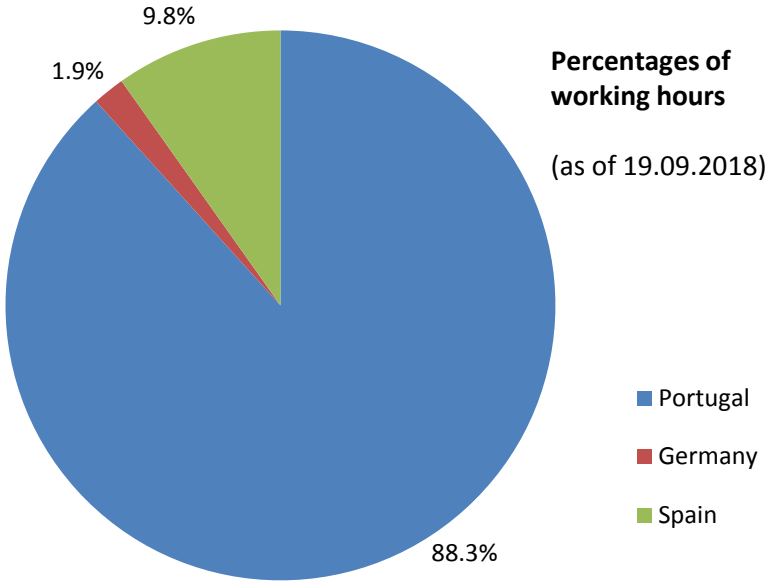
Pictures of the construction site

Workers on Site

- Construction Start 20.12.2017

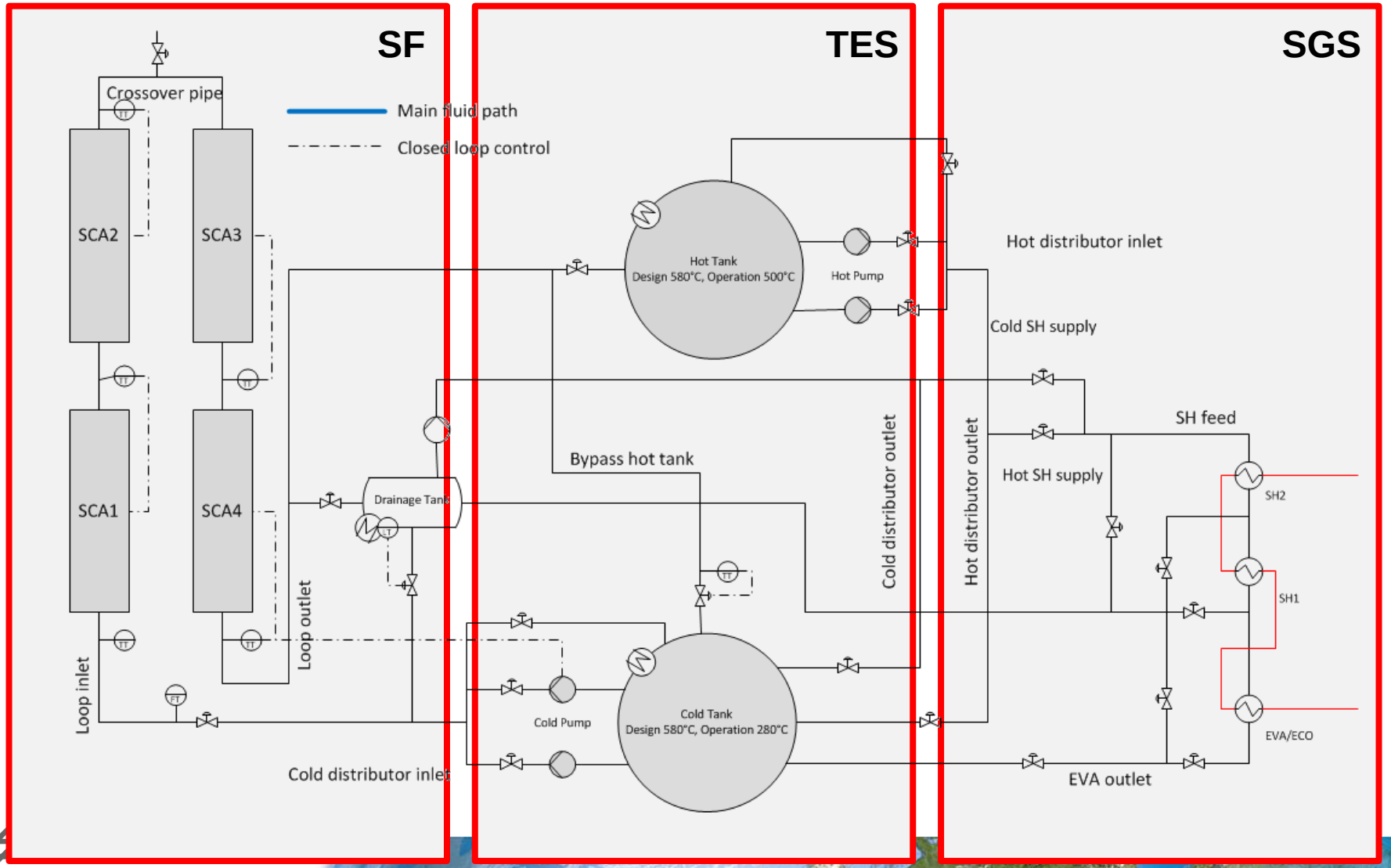
- As of 19.09.2018
  - 19 different companies from Portugal, Spain and Germany contracted by HPS2 that worked on-site

    (e.g. Notified Bodies, Mechanical, Civil companies, Security, Industrial Cleaning Companies, Welding Companies, Fitters, Iron Workers, Gardeners, etc.)



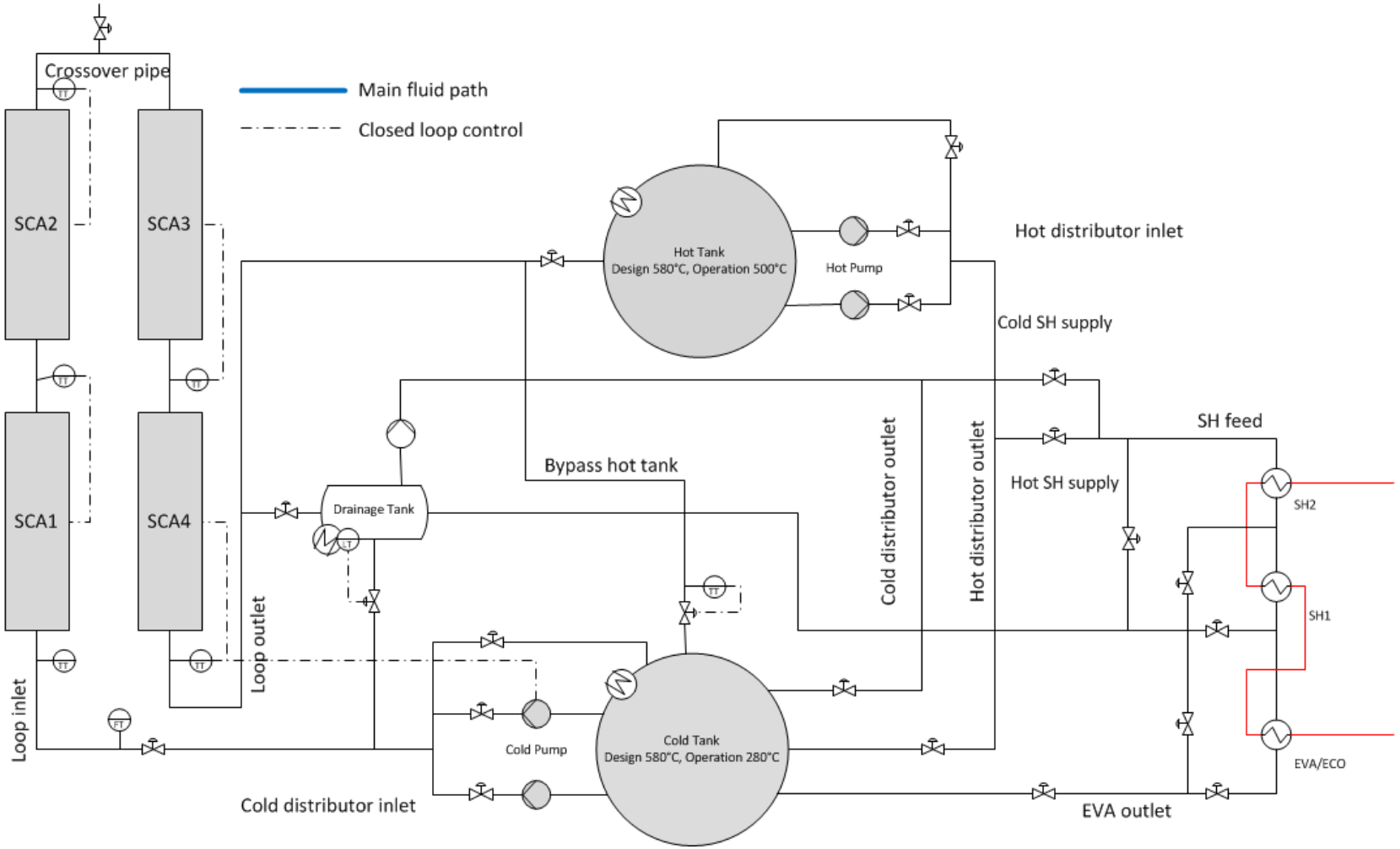
- As of 19.09.2018:
  - In 24.480 working hours there is **ZERO** injuries with loss time of any worker!

The HPS2 process

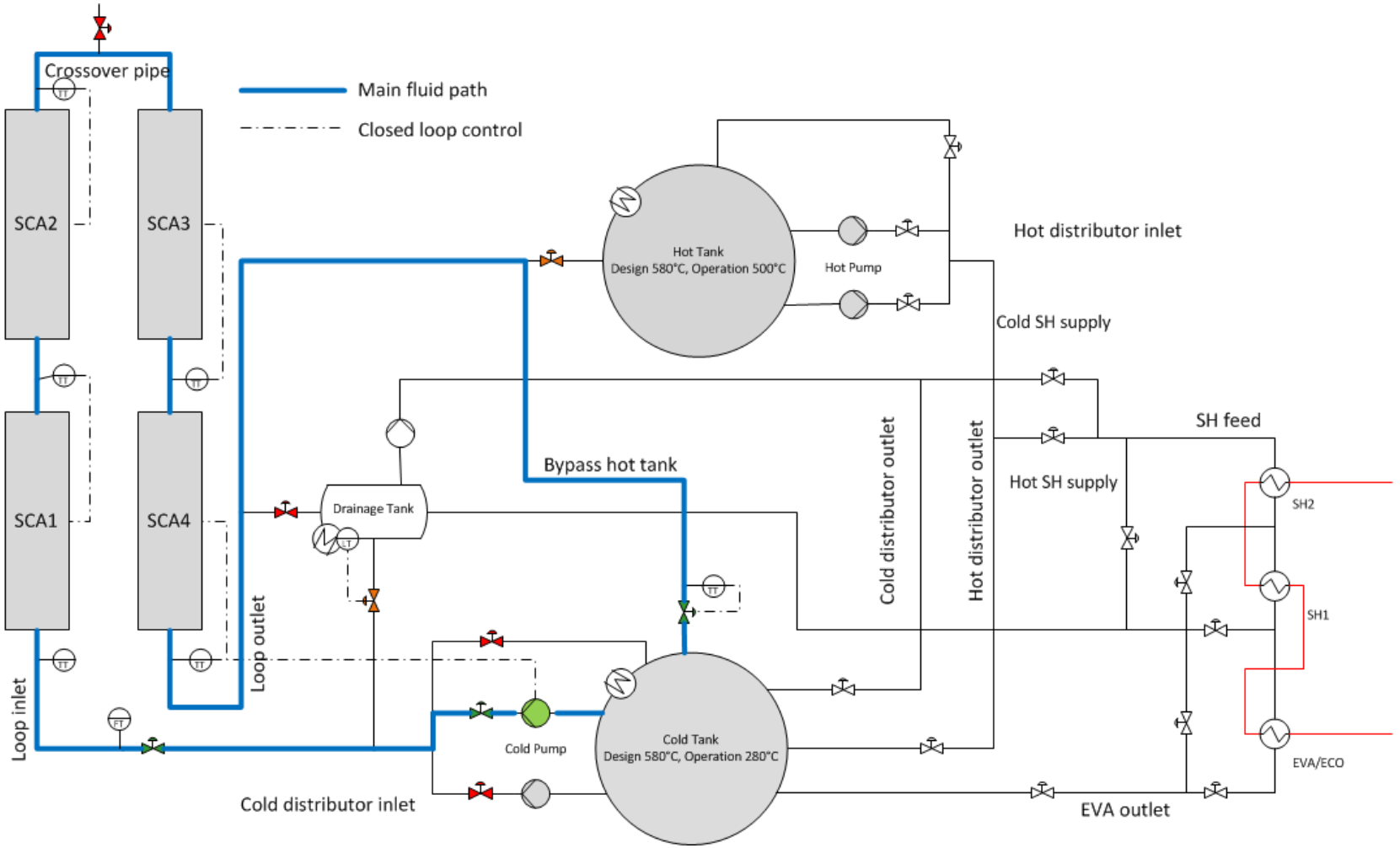


The HPS2 process

Overview

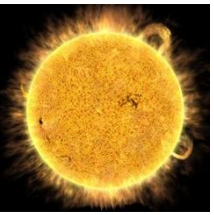


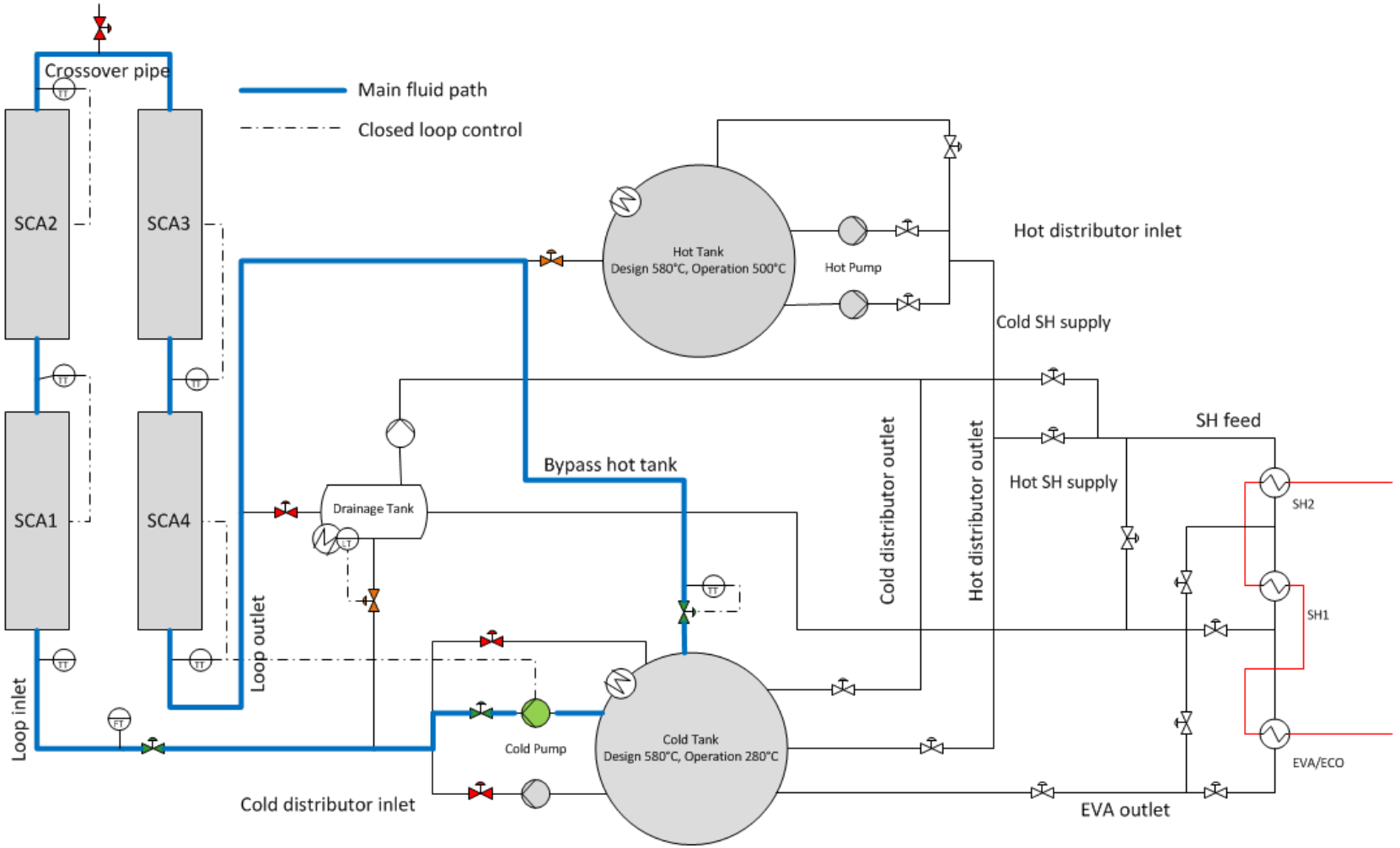
The HPS2 process
Op: SF antifreeze



The HPS2 process

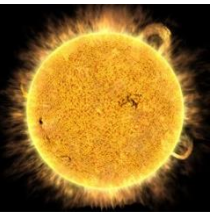
Op: SF start-up

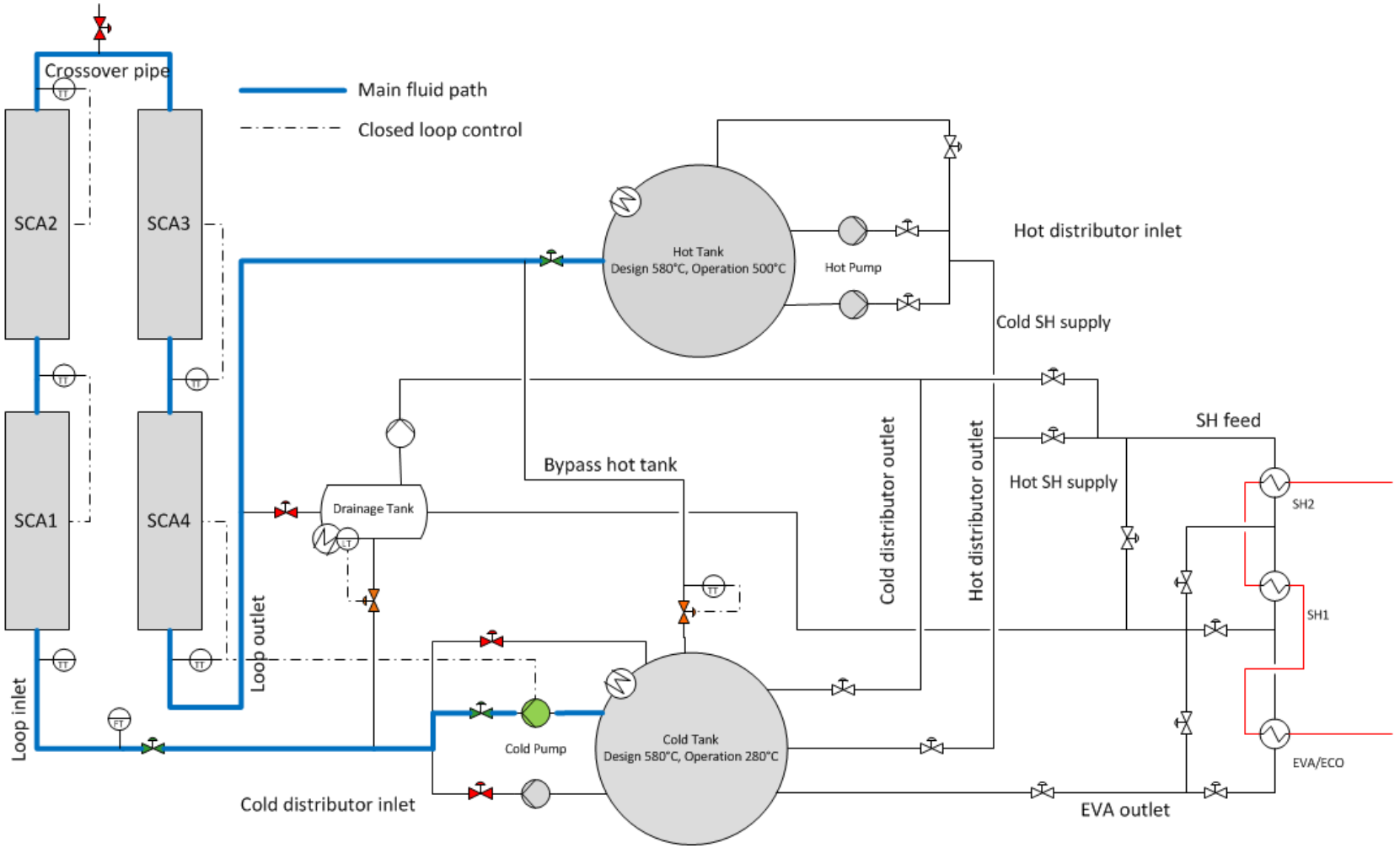




The HPS2 process

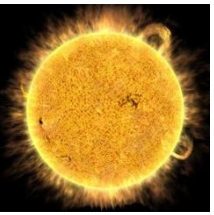
Op: SF normal

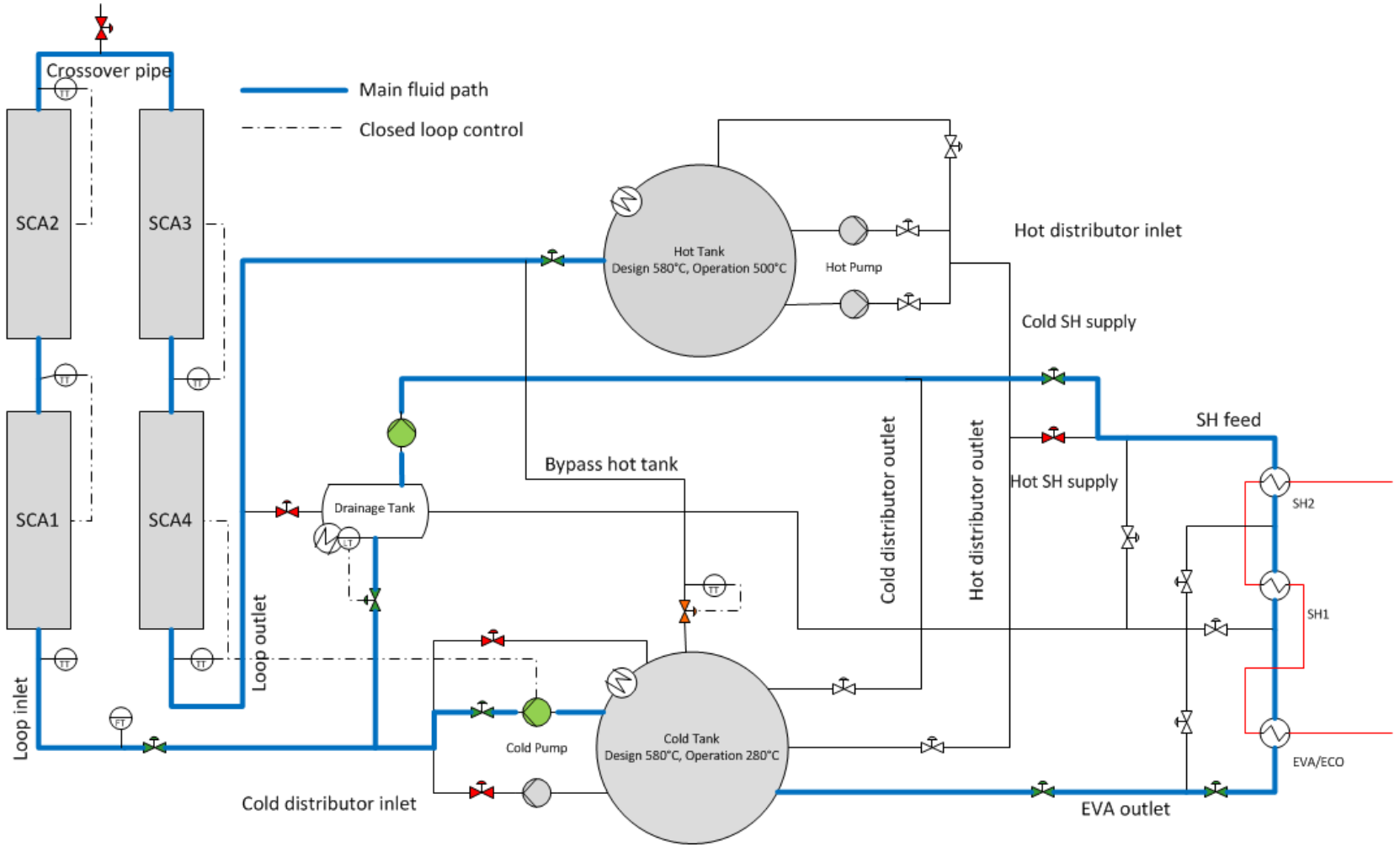




The HPS2 process

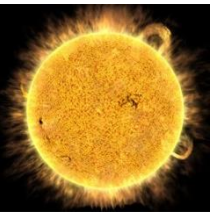
Combined: SF normal, SGS antifreeze

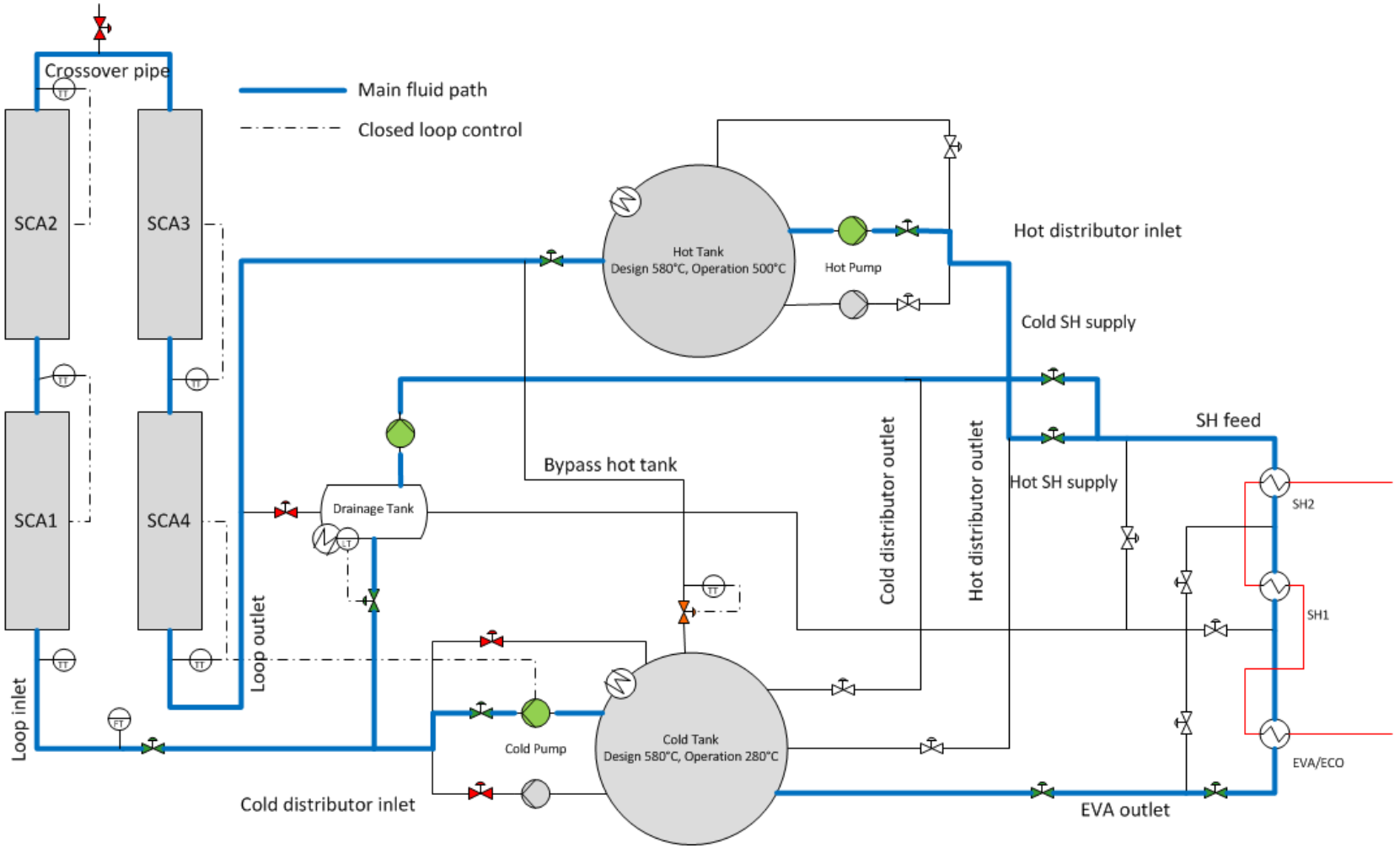




The HPS2 process

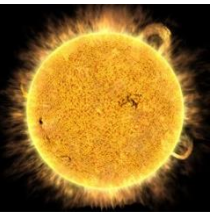
Combined: SF normal, SGS startup/shutdown

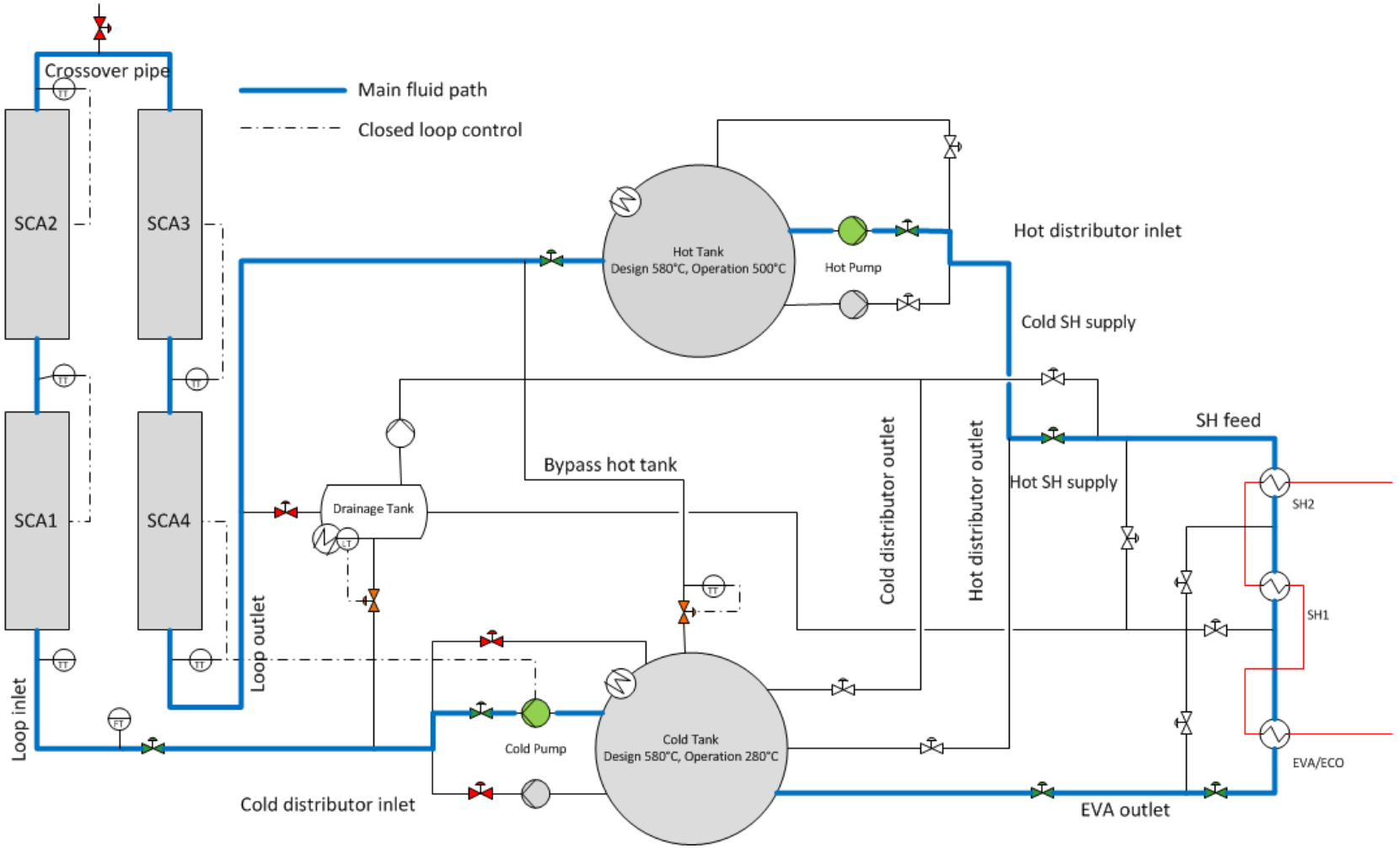




The HPS2 process

Combined: SF normal, SGS normal





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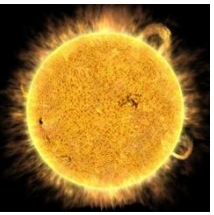

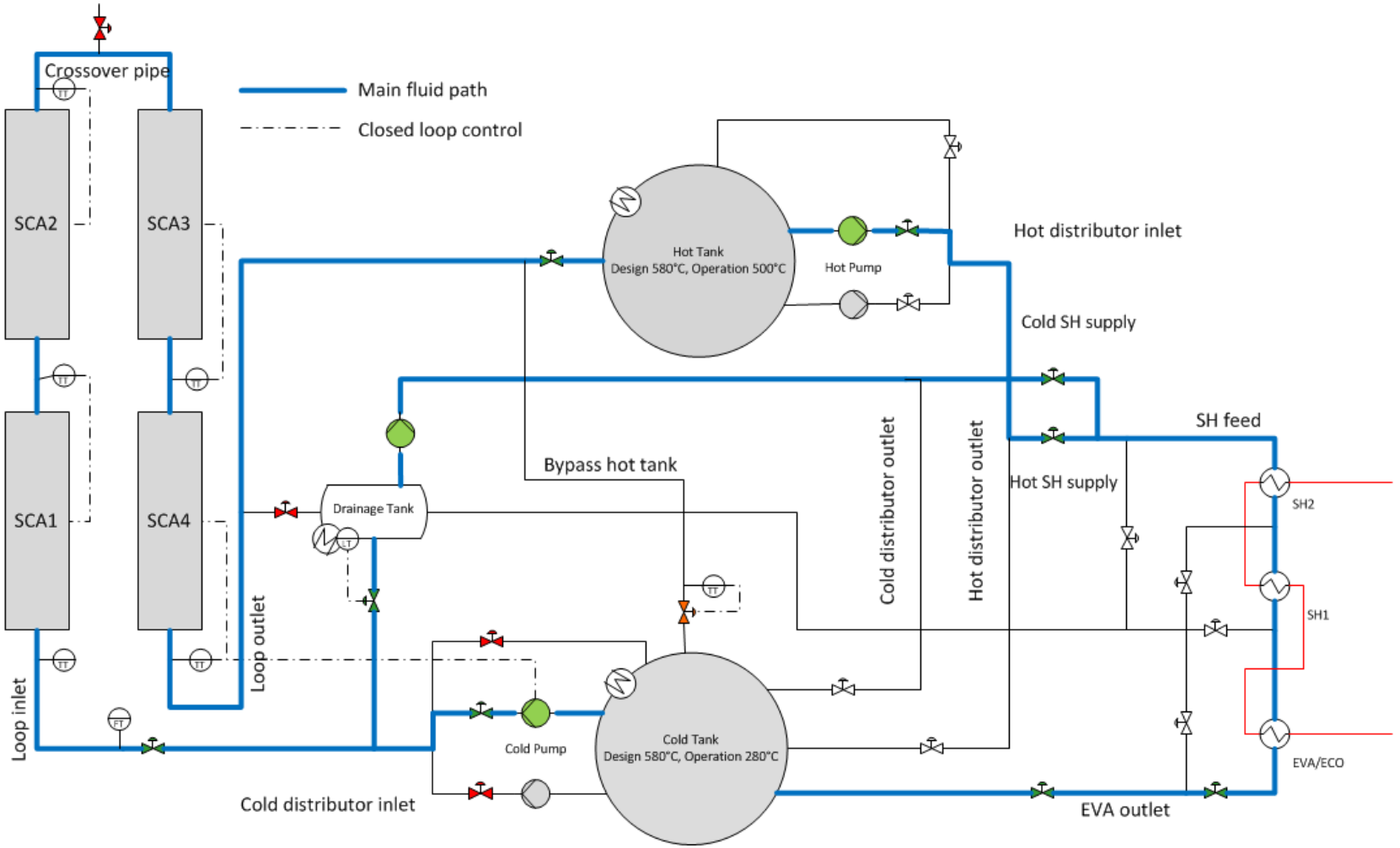

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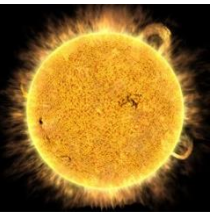

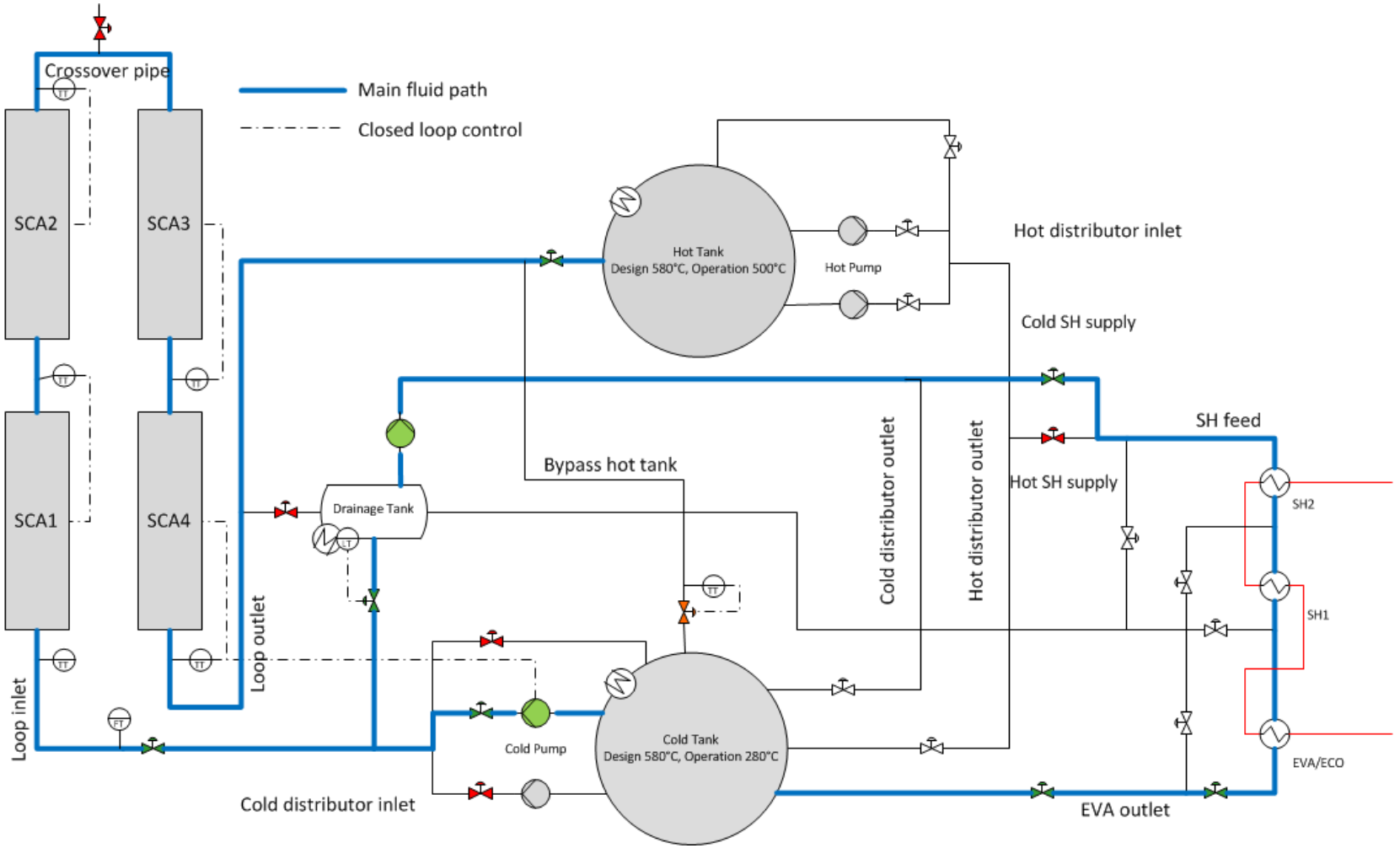

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Thank you for your attention!

HPS2 strives to demonstrate the feasibility of operation of a solar thermal power plant in a safe and reliable manner.

Acknowledgements:

- IPES
- University of Èvora – Team of Catedra ER, Team of Administration
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